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Rhus longispina and *Rhus pterota*, two hitherto confused South African shrubs

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Received 25 June 1993; revised 18 October 1993

Rhus longispina Eckl. & Zeyh. and *R. pterota* Presl are two woody shrubs which are common in the eastern and southern Cape Province. Because of shared habitats and a superficial morphological similarity, these species have been regarded as conspecific and known as *R. longispina* for over one hundred and fifty years. A table showing the diagnostic characters separating the two species and a detailed description of each is given, followed by a list of selected specimens indicating their distribution.

Rhus longispina Eckl. & Zeyh. en *R. pterota* Presl is twee houtagtige struike wat algemeen in die oostelike en suidelike Kaapprovinsie voorkom. Omdat hulle habitatte deel en morfologies oppervlakkig ooreenstem, is hierdie twee spesies die afgelope honderd en vyftig jaar as konspesifiek beskou en staan as *R. longispina* bekend. 'n Tabel waarin die diagnostiese kenmerke van die twee spesies uiteengesit word en 'n gedetailleerde beskrywing van elk word voorsien, asook 'n lys van geselekteerde eksemplare wat hul verspreiding aandui.

Keywords: Anacardiaceae, *Rhus*, taxonomy, Cape Province.

Introduction

It is generally accepted by botanists that *Rhus* is a taxonomically difficult genus. Schonland (1930), Burtt Davy (1932) and Fernandes and Fernandes (1966) had difficulty in determining and delimiting the species and many current herbarium taxonomists experience the same problem. In subgenus *Thezera* (DC) K. Koch, to which the African species belong, Moffett (1993) attributed this to dioecy, minute flowers, lack of mature fruit due to frugivory, and the presence of many putative hybrids.

Rhus longispina Eckl. & Zeyh. and *R. pterota* Presl, collected and described over one hundred and fifty years ago, are among those species which, despite three subsequent taxonomic treatments (Sonder 1860; Engler 1883; Schonland 1930) are still confused today. This, however, is not surprising as Ecklon and Zeyher described and distributed the two species as one, *R. longispina*, under their number *1116*. In some collections, these mixed gatherings were even mounted under one label on the same sheet (Figure 1). A further reason for the confusion is that in the possible type area near Uitenhage, eastern Cape Province, the two species are sympatric and occasionally intermingle in the thorn scrub (Figure 2).

When working through the great number of recently collected Drège, Ecklon and Zeyher exsiccatae that had arrived in Europe, Presl of Prague realized that *Ecklon & Zeyher 1116* was heterogeneous and described the species with broader winged petioles as *Rhus pterota* (*pteron*: Greek for wing) (Presl 1844). Subsequent botanists either did not know of Presl's publication or chose to ignore it.

Rhus pterota had earlier been recognized as an undescribed species by William Burchell, for on his specimen *4795* which he had collected on 1814-02-18 and which is now in the Kew Herbarium, London, he had written '*Rhus robustum, durum.*'

In his detailed revision of the South African species of *Rhus*, Schonland (*op. cit.*), unaware that he was dealing with two species, understandably produced a confused account of *R. longispina*. On p.89 he wrote: 'The affinities of this species seem to point to *Rh. rigida* [(*R. rimosa* Eckl. & Zeyh.), my parentheses] though it is often placed near *Rh. lucida*. In some respects it approaches *Rh. ciliata* Licht. The great variability of this species in the size of leaflets, the length and breadth of petioles is noteworthy, and while in other species of *Rhus* great variability raises a suspicion of hybridization, such a suspicion cannot be entertained here.' Of the 21 numbered collections cited by Schonland under *R. longispina*, I have studied 18. Of these 18, 4 are *R. longispina*, 1 is *R. pallens* Eckl. & Zeyh., and 13 are *R. pterota*.

Despite their sometimes similar habit and leaf shape, a close morphological examination of *Rhus longispina* and *R. pterota* shows that these two species are not closely related and belong to two different groups in the subgenus. *R. longispina* is related to *R. pallens* Eckl. & Zeyh. and *R. burchellii* Sond. ex Engl., whereas *R. pterota* is related to *R. horrida* Eckl. & Zeyh. and possibly also to *R. problematodes* Merxm. & Roessl.

A summary of the diagnostic characters of *R. longispina* and *R. pterota* is given in Table 1.

Rhus longispina *Eckl. & Zeyh.*, Enumeratio plantarum africae australis 2: 148 (1836) p.p.; Sond.: 520 (1860) p.p.;

Figure 1 *Ecklon & Zeyher 1116* in the South African Museum collection of the Compton Herbarium, National Botanical Institute, Cape Town. The specimen on the right is the lectotype of *Rhus longispina* and that on the left an isotype of *R. pterota*.

Figure 2 *Rhus pterota* (*Moffett 2427*) on the left and *R. longispina* (*Moffett 2429*) on the right, growing together between Windmolen and Graskop, east of Uitenhage, eastern Cape Province.

Diels: 575, 635 (1898) p.p.; Schonl.: 239 (1911) p.p.; Schonl.: 88 (1930) p.p.; Moffett: 82 (1993). Type: eastern Cape Province, *Ecklon & Zeyher 1116* p.p. (SAM, right-hand side of sheet, lecto.! *vide* Moffett 1993; GRA!, M!, P!, PRC photo.!, S!, W!, isolecto.).

Toxicodendron longispinum (Eckl. & Zeyh.) Kuntze: 154 (1891).

Rhus spathulata Eckl. & Zeyh.: 148 (1836) p.p.; Walp.: 553 (1842). Type: eastern Cape Province, Uitenhage, near Zwartkops River, *Ecklon & Zeyher 1119* p.p. (S, lecto.!, p.p. excl. specim. *R. pallens* Eckl. & Zeyh. on same sheet, *vide* Moffett 1993; P!, SAM!, TCD!, isolecto.).

Much-branched, multistemmed, evergreen, rounded, armed shrub up to 4 m high. *Bark* granular to rough and slightly fissured; branches finely striate, pale grey-brown to dull yellow-brown with somewhat squarrose spinous spurs. *Leaves* trifoliolate, petiolate, somewhat fasciculate to crowded on spurs; petiole semiterete, canaliculate and occasionally margined above, (5–) 9 (–16) mm long; leaflets sessile, subcoriaceous, concolorous, olive-green above, slightly paler below, often laccate, occasionally glaucescent, hypostomatous, glabrous; lamina oblanceolate, spatulate to narrowly obovate,

Table 1 Comparison of diagnostic characters of *Rhus longispina* and *R. pterota*

Character	*Rhus longispina*	*Rhus pterota*
Drupe	Oblate, ellipsoid 3.5 × 2.3 – 6.8 × 4.7 mm, chestnut-brown, drying dark brown; resinous juice and dry drupes astringent but palatable	Elliptic, ellipsoid 5.6 × 4.3 – 6.4 × 4.9 mm, slightly asymmetric, dark reddish brown, drying black; resinous juice and dry drupes pungent, distinctly unpalatable leaving a burning sensation in the mouth
Foliage	New growth glabrous, shiny	New growth russet, glandular
Leaves	Petioles semiterete, occasionally margined; leaflets olive-green above, slightly paler below, often laccate; apex often emarginate	Petiole flattened, distinctly winged; leaflets dull grey-green above, slightly paler below, never laccate; apex never emarginate
Venation	Secondary veins impressed, not prominent	Secondary veins prominent above, dull yellow, divided towards margin, often somewhat reversed
Habit	When mature, large rounded shrubs up to 4 m high	When mature, somewhat untidy squarrose shrubs up to 2 m high
Panicles	Axillary and terminal, latter prominently exposed	Fasciculate, not prominently exposed
Bark	Pale grey-brown to dull yellowish on younger branches, granular to slightly striate	Grey, granular often lichen-covered
Habitat and distribution	Occurs on diverse substrates near the coast and widespread in the Little and Great Karoo	Occurs on calcareous substrates along the coast and adjacent interior

often mucronulate; margin entire, slightly revolute; venation kladodromous, midrib slightly prominent above and below, other veins impressed, usually obscure; terminal leaflets (10–) 23 (–40) × (6–) 10 (–20) mm, lateral leaflets (8–) 16 (–30) × (4–) 8 (–15) mm. *Panicles* up to 50 mm long, axillary and terminal, males much branched, multiflorous, females less branched, drupes crowded, branches furfuraceous. *Flowers* minute, about 2 mm across, pedicellate, 5-merous, sepals and petals yellowy green, males with prominent disc, females with staminodes. *Drupe* oblate, ellipsoid, glabrous, shiny, chestnut-brown 3.5 × 2.3 – 6.8 × 4.7 mm (Figure 3).

Rhus longispina occurs in dry habitats and ranges from near Queenstown in the north-eastern Cape through the eastern, southern and western Cape interior to near Alexander Bay in Namaqualand. It is especially plentiful in the lower Great Karoo where it forms large, beautifully rounded shrubs near

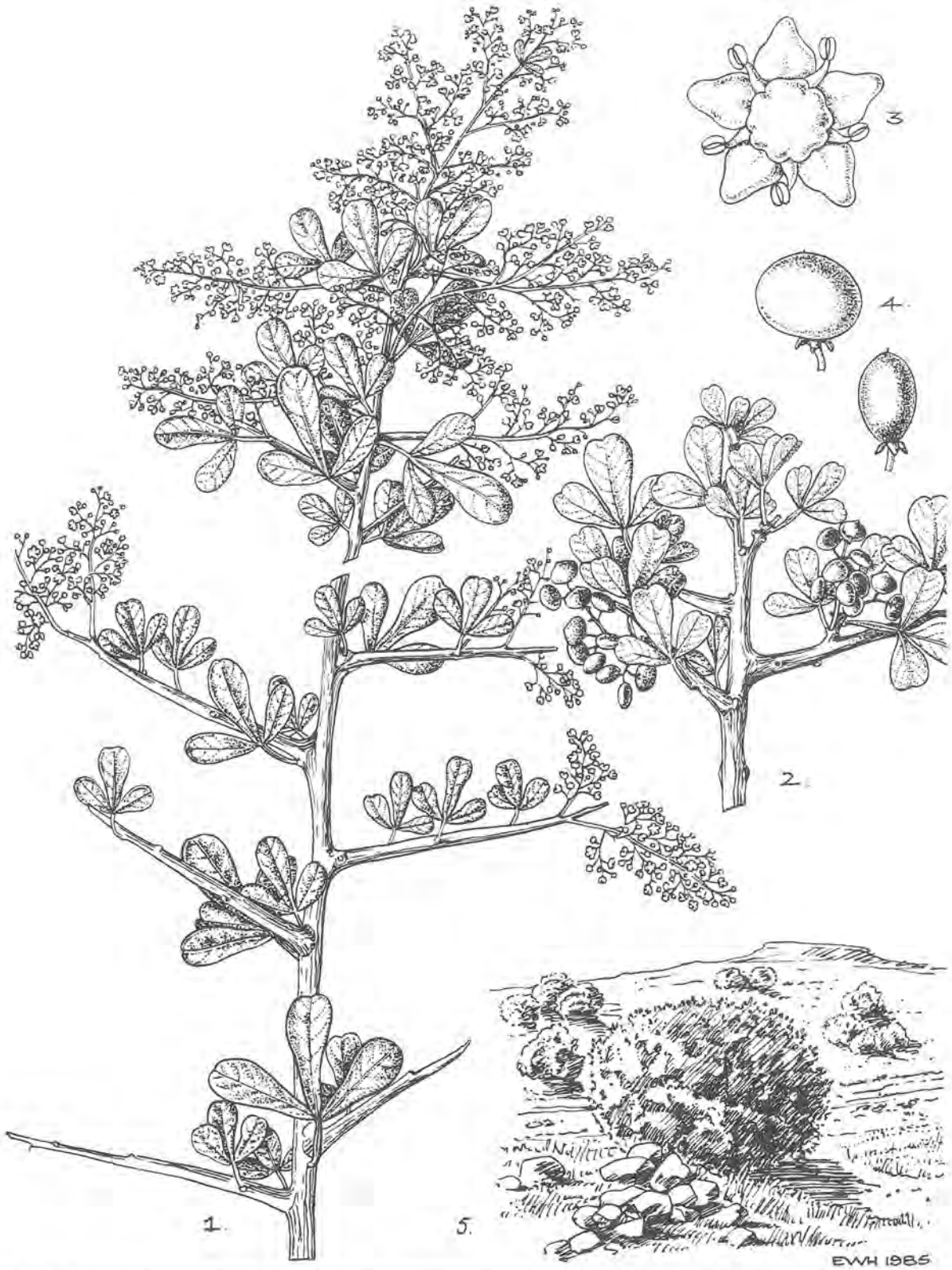

Figure 3 *Rhus longispina*. 1. Branch with male inflorescences, ×1 (*Bolus 660*). 2. Fruiting branch, ×1 (*Moffett 2625*). 3. Male flower, ×15 (*Brink 469*). 4. Drupe, ×4 (*Moffett 2625*). 5. Habit.

watercourses and dams. It becomes scarcer westwards and is rare in the north-western Cape. There is also a single record from Oribi Gorge near Port Shepstone, Natal (Figure 4).

Palmer and Pitman (1973) recorded that the low dense branches and foliage of this species shelter many different wild animals and birds and that the species is also host to at least one butterfly, *Phasis braueri*. The exposed sweetly scented male flowers certainly attract many different kinds of flying insects. *Rhus longispina* should make an excellent impenetrable hedge in dry gardens. In the *National list of trees* it was given the number 388 and vernacular names Thorny Currant, Doringtaaibos (De Winter *et al.* 1978).

Selected specimens examined

The arrangement is according to the quarter-degree system of Leistner and Morris (1976) with only one specimen cited per quarter degree. Herbarium abbreviations are according to Holmgren *et al* (1990).

CAPE PROVINCE

—**2816** (Oranjemund): Boegoeberg South, Alexander Bay (–DC), *Le Roux & Ramsey 169* (STE).

—**3017** (Hondeklipbaai): Diknek Farm, 14 km east of Hondeklip Bay (–AD), *Rourke 1573* (NBG).

—**3117** (Lepelfontein): Graauw Duinen, Brand se Baai (–BD), *Le Roux & Ramsey 120* (STE).

—**3119** (Calvinia): Ripjoen Mountains, Calvinia (–BD), *Marloth 10300* (PRE).

—**3126** (Queenstown): 12 km west of Queenstown (–DC), *Moffett 2600* (PRE); Queenstown (–DD), *Rogers s.n.* (GRA).

—**3218** (Clanwilliam) : Nortier Experimental Farm, Lamberts Bay (–AB), *Boucher 2613* (STE); near Clanwilliam (–BA), *H.C. Taylor 3947* (PRE, STE).

—**3221** (Merweville): Vinkfontein, Bo-Uitspanningsrivier, Merweville (–CA), *Moffett 1561* (PRE).

—**3223** (Rietbron): 13 km west of Aberdeen (–BA), *Moffett 2318* (PRE).

—**3224** (Graaff-Reinet): Valley of Desolation, Graaff-Reinet (–AD), *Moffett 2862* (PRE); mountains near Graaff-Reinet (–BC), *Bolus 660* (BOL, GRA, K, PRE); Aasvoëlberg, between Graaff-Reinet and Petersburg (–BD), *Moffett 2623* (PRE).

—**3225** (Somerset East): Buffelshoek Pass north of Pearston (–AC), *Moffett 2867* (PRE); 22 km north-east of Cradock (–BB), *Moffett 2604* (PRE); Cookhouse (–DB), *Rogers 3457* (BOL, GRA).

—**3226** (Fort Beaufort): Mountain Martha, south of Tarkastad (–AB), *Moffett 2898* (PRE); Between Eildon and Craig Rennie (–AC), *Moffett 2887* (PRE); 9 km north of Adelaide (–CB), *Marais 436* (GRA, K, PRE); 10 km south of Fort Beaufort (–DC), *Gibbs-Russell 3029* (PRE, UFH); Dal Eendracht Farm south of Alice (–DD), *Giffen 867* (PRE, UFH).

—**3227** (Stutterheim): Swart Kei River, 24 km north of Cathcart (–AA), *Roberts 1819* (PRE); Keiskammahoek (–CA), *Kotsokoane in J 25803* (J); Invergali Farm, Stutterheim District (–CB), *Edwards 418* (NU); Fort Cox Farm, near Middledrift (–CC), *Brickhill s.n.* (GRA); Kingwilliamstown (–CD), *Tyson 2199* (SAM); Rabousie River near Komgha (–DB), *Flanagan 701* (BOL, GRA, PRE, SAM).

—**3319** (Worcester): La Chasseur, Robertson (–DC), *Moffett 2658* (PRE); Vrolijkheid Nature Reserve, Robertson (–DD), *Burgers 60* (PRE).

—**3320** (Montagu): 4 km north of Matjesfontein (–BA), *Van Jaarsveld 1710* (NBG).

—**3321** (Ladismith): South entrance to Seven Weeks Poort (–AD), *H.C. Taylor 8021* (K, PRE, SRGH); Die Ou Tol, Garcia's Pass (–CC), *Moffett 2358* (PRE); Sandkraal Farm, north side of Langeberg, east of Garcia's Pass (–CD), *Moffett 2357* (PRE); Gamkapoort Nature Reserve, Dwyka River Koppies (–DB), *Cattell & Cattell 14* (STE); Langberg Farm, north side of Langeberg (–DC), *Moffett 2364* (PRE).

—**3322** (Oudtshoorn): 3 km south of Prins Albert (–AA), *Moffett 1564* (PRE), Waenskloof, Upper Cango Valley (–AC), *Moffett 561* (PRE); Armoed Junction, Oudtshoorn (–CA), *Britten 1747* (PRE); Die Krans Farm, Oudtshoorn (–CB), *Dahlstrand 1492* (PRE, STE); Doornkraal Farm, De Rust (–DA), *Dahlstrand 2177* (C, PRE, STE).

—**3323** (Willowmore): Willowmore (–AD), *Pole-Evans 23* (PRE); 21 km north of Uniondale (–CA), *Fourcade 4366* (BOL).

—**3324** (Steytlerville): Between Miskraal and Smitskraal (–CB), *Hugo 1442* (STE); west bank of Gamtoos River near Hankey (–DD), *Fourcade 2280* (BOL, K).

—**3325** (Port Elizabeth): Glen Connor (–AC), *Marloth 4148* (PRE); Rhino Camp, Addo National Park (–BC), *Hall-Martin 5961* (PRE); 3 km east of Paterson (–BD), *Moffett 2439* (PRE); Groendal Wilderness Reserve, Kariega Catchment Basin, Uitenhage District (–CA), *Scharf 1939* (PRE); Uitenhage (–CD), *Thode A2632* (K, NH, PRE); between Windmolen and Graskop, east of Uitenhage (–DA), *Moffett 2429* (PRE); between Coega River and Sundays River (–DB), *Moffett 3197* (PRE); Perseverence near Port Elizabeth (–DC), *Rodin 1285* (BOL, K, PRE).

—**3326** (Grahamstown): 16 km north of Grahamstown (–AB), *Marloth 12612* (PRE); Plutos Vale, Grahamstown District (–BA), *Brink 469* (GRA); Vaal Vlei Estate, Grahamstown (–BC), *Mogg 4642* (PRE); Bushman's River Poort, Alexandria (–CB), *Archibald 4387* (PRE); Rufane River near Port Alfred (–DB), *Moffett 2498* (PRE).

—**3327** (Peddie) : Keiskamma River Cutting near Hamburg (–AB), *Moffett 2519* (PRE).

—**3420** (Bredasdorp): Lang Elsies Kraal, Bontebok Park, Swellendam (–AB), *H.C. Taylor 8258* (STE).

—**3422** (Mossel Bay): Mossel Bay (–AA), *Schlechter 5725* (BM, BOL, COI, G, GRA, K, S, W, WU, Z).

NATAL

—**3030** (Port Shepstone): Oribi Gorge (–CB), *Nicholson 615* (NH).

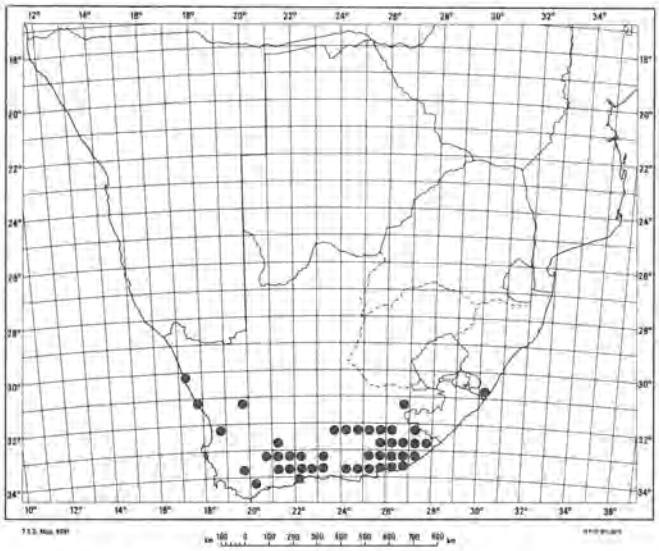

Figure 4 Geographic distribution of *Rhus longispina*.

Rhus pterota *Presl,* Botanische Bemerkungen: 44 (1844); Moffett: 115 (1993). Type: eastern Cape Province, *Ecklon & Zeyher 1116* (PRC, holo. photo.!; GRA!, M!, P!, S!, SAM!, iso.).

R. longispina sensu Eckl. & Zeyh. et auct. p.p.

Much-branched, evergreen, armed, squarrose shrub, 1.5 – 2 m high, rarely to 4 m. *Bark* grey, granular, often lichen-covered. Branching squarrose, short shoots ending in sharp spines. *Leaves* fasciculate, crowded on dwarf outgrowths of older branches and spines, trifoliolate, petiolate; petiole winged, flattened or canaliculate above, (7–) 17 (–39) mm long; leaflets sessile, rigidly coriaceous, slightly discolorous, dull grey-green above, slightly paler below, glabrous, hypostomatous; lamina

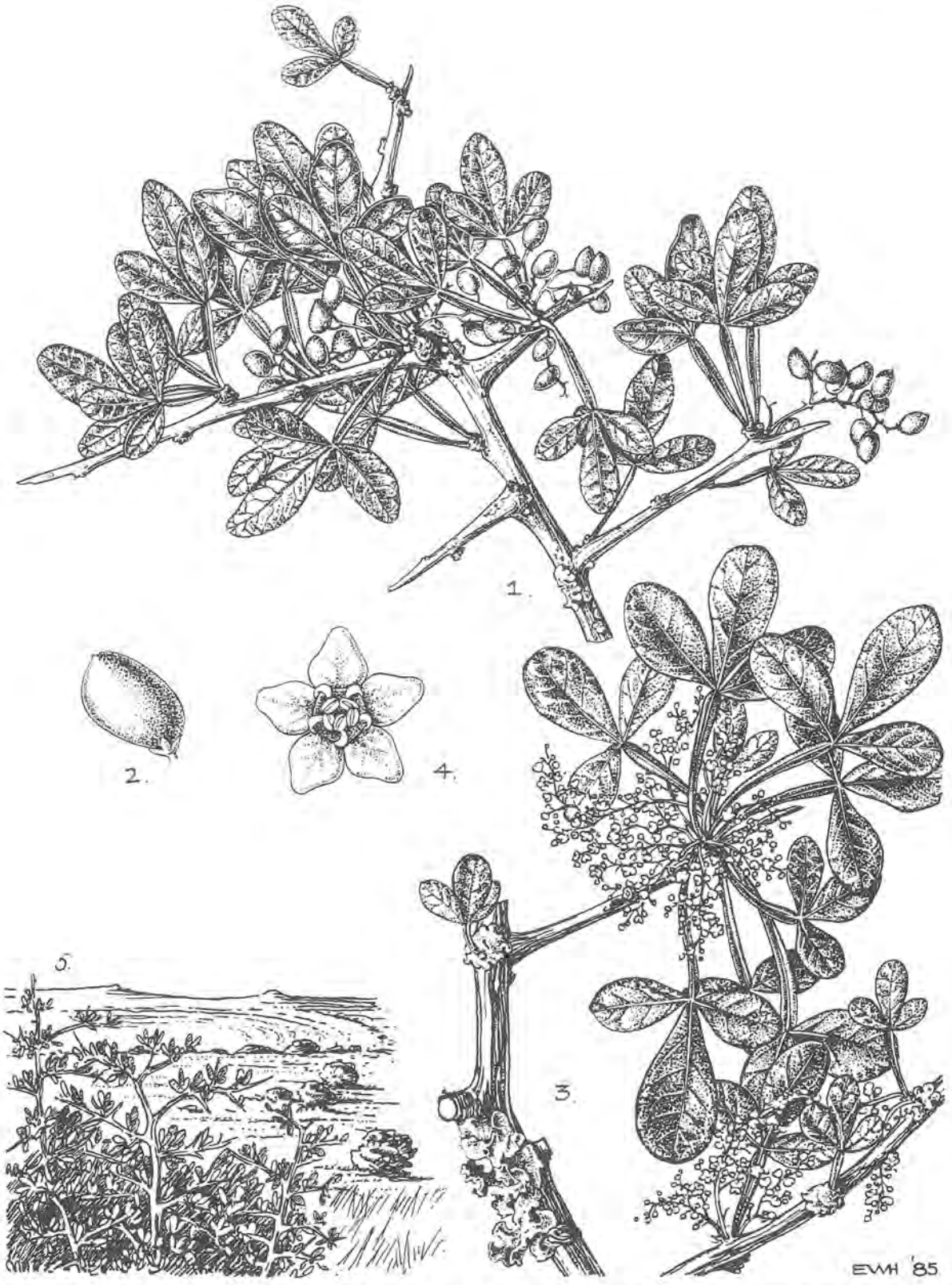

Figure 5 *Rhus pterota*. 1. Fruiting branch, ×1 (*Moffett 2695*). 2. Drupe, ×3 (*Moffett 2695*). 3. Branch with male inflorescence and foliose lichen, ×1 (*Moffett 2489*). 4. Male flower, ×8 (*Moffett 2489*). 5. Habit.

elliptic to obovate, base cuneate, apex rounded; margin entire, revolute; venation kladodromous, midrib and secondaries prominent, dull yellow above, slightly prominent below, secondaries 2 or 3 per cm, divided towards margin, often somewhat reversed; terminal leaflets (13–) 25 (–40) × (5–) 10 (–19) mm, lateral leaflets (9–) 19 (–26) × (5–) 9 (–18) mm. *Panicles* furfuraceous, fasciculate, up to 35 mm long, males profusely crowded. *Flowers* minute, about 3 mm across, pedicellate, 5-merous, sepals and petals greenish yellow, males with prominent disc, females with staminodes. *Drupe* elliptic, ellipsoid, slightly asymmetric, glabrous, shiny, fleshy, dark reddish brown, drying black, 5.6 × 4.3 – 6.4 × 4.9 mm, resinous juice pungent, unpalatable (Figure 5).

Rhus pterota is an untidy, much-branched spiny shrub which ranges along the coast and adjacent interior from East London in the east to the De Hoop Nature Reserve near Bredasdorp in the southern Cape. There is, however, a disjunct population 250 km further west in the Postberg Nature Reserve near Saldanha Bay (Figure 6). According to the manager of this reserve (pers. comm., July 1980), the plants provide good browse for the antelope but can be a nuisance as they puncture off-road vehicle tyres.

Unlike many of the other species whose fruit I have tasted and found to be sour and refreshing, the drupes of *R. pterota* are pungent and unpalatable. Both fresh (*Moffett 2695* and *3188*) and eight-year-old dried drupes (*Moffett 2695*) leave an acrid, burning sensation in the mouth and throat for up to three hours after tasting. I have recently suggested that this species be included in the *National list of trees* and be given the following number and vernacular names: 391.1, Spike-thorn Currant, Pendoringtaaibos (Moffett 1994).

Selected specimens examined

Arranged according to Leistner and Morris (*op. cit.*). Herbarium abbreviations are according to Holmgren *et al.* (*op. cit.*).

CAPE PROVINCE

—3227 (Stutterheim): near Nahoon River mouth (–DD), *Galpin 5689* (GRA, PRE).

—3318 (Cape Town): Near entrance to Postberg Nature Reserve (–AA), *Moffett 2695* (BOL, K, MO, NBG, PRE, STE).

—3321 (Ladismith): Herbertsdale (–DD), *Moffett 2379* (PRE).

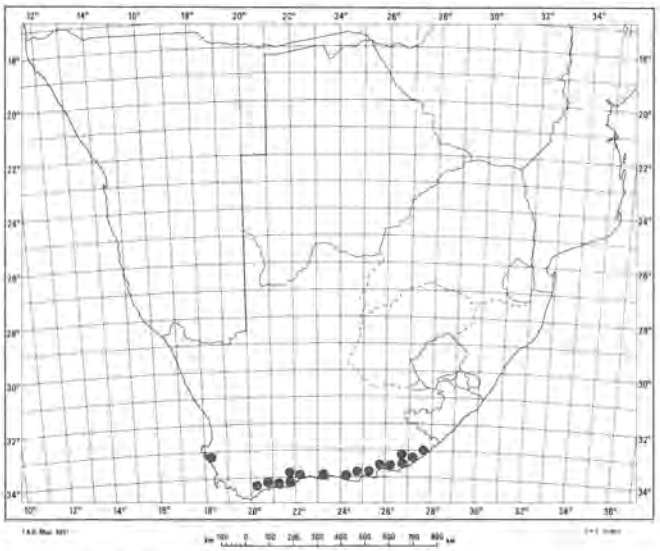

Figure 6 Geographic distribution of *Rhus pterota*.

—3323 (Willowmore): northern slopes of Kouga, overlooking Studtis (–DB), *Campbell 255* (STE).

—3324 (Steytlerville): Paul Sauer Dam, Kouga River near Patensie (–DA), *Moffett 3188* (PRE); Phillips Tunnel, Hankey (–DD), *Moffett 3189* (PRE).

—3325 (Port Elizabeth): Amanzi, Uitenhage (–CB), *Wells 3160* (PRE); Gamtoos River cuttings, between Humansdorp and Port Elizabeth (–CC), *Moffett 2426* (PRE); Krakakamma (–CD), *Zeyher 2245* (K, P, PRE, SAM); between Windmolen and Graskop, east of Uitenhage (–DA), *Moffett 2427* (PRE); 6 km east of Ncanaha (–DB), *Comins 1004* (GRA, PRE); Aloes, Uitenhage (–DC), *I.L. Drège 3165* (GRA).

—3326 (Grahamstown): near Alicedale (–AC), *Johnson 1001* (K, PRE); Botha's Hill, near Grahamstown (–BA), *Dyer 1298* (GRA); Grahamstown (–BC), *Dyer 61* (GRA, PRE, PRF); near Coombes (–BD), *Bayliss BRI. B.1019* (PRE); 50 km north-east of Port Elizabeth (–CA), *Taylor s.n.* (GRA); Alexandria (–CB), *Wells 2659* (K, PRE); Kenton-on-Sea (–DA), *Moffett 2485* (PRE); Kariega Valley, Bathurst (–DB), *Acocks 11049* (PRE).

—3327 (Peddie): Mpekweni, near Fish Mouth (–AC), *Moffett 2512* (PRE); East London (–BB), *Breyer in TM 17158* (PRE).

—3420 (Bredasdorp): De Hoop Nature Reserve (–AD), *Lewis 5183* (NBG); Duiwenhoks River, Heidelberg (–BB), *H.C. Taylor 2733* (STE).

—3421 (Riversdale): 10 km east of Riversdale (–AB), *Moffett 1507* (PRE); Puntjie (–AC), *Boucher 2670* (STE); Still Bay (–AD), *Muir 1894* (PRE); Skilpadgat, 8 km north-west of Albertinia (–BA), *Taylor 208* (NBG); 13 km south of Herbertsdale (–BB), *Moffett 2381* (PRE); Fransmanshoek (–BD), *Moffett 1585* (PRE).

—3422 (Mossel Bay): 12 km north of Mossel Bay (–AA), *Moffett 1582* (PRE).

—3423 (Knysna): sandhills near Read's Hotel, Knysna (–AA), *J. Gillett 1561* (BOL); Robberg Nature Reserve, Plettenberg Bay (–AB), *H.C. Taylor 7706* (STE).

—3424 (Humansdorp): Seekoei River Reserve (–BB), *Montgomery 328* (STE).

Acknowledgements

I wish to thank the National Botanical Institute for allowing me to use Ellaphie Ward-Hilhorst's superb illustrations of these two species, and the Curators of the cited herbaria for giving me access to their specimens. I am also grateful to the Council of the University of the North and the Research Committee at its Qwaqwa Campus, for their support.

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An overview of the physical environment and vegetation units of the Ba and Ib land types of the Pretoria–Witbank–Heidelberg area

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Received 24 June 1993; revised 21 October 1993

An analysis of the physical environment and associated vegetation of the study area is presented. Relevés were compiled in 265 stratified random plots. Care was taken to avoid severely disturbed areas and ecotones. A TWINSPAN classification, refined by Braun-Blanquet procedures, revealed eight vegetation units which can be regarded as distinct ecological units. A hierarchical classification, description and ecological interpretation of the eight vegetation units are presented. These ecological units should be taken into account in the compilation of management programmes for the natural resources of the study area.

'n Analise van die fisiese omgewing en plantegroei van die studiegebied word aangebied. Relevés is in 265 gestratifiseerde ewekansig gekose monsterpersele saamgestel. Oormatig versteurde gebiede en ekotone is deurgaans vermy. Deur middel van 'n TWINSPAN klassifikasie, wat verfyn is deur Braun-Blanquet prosedures, is agt plantegroei-eenhede onderskei wat as aparte ekologiese eenhede beskou kan word. 'n Hiërargiese klassifikasie, beskrywing en ekologiese interpretasie van die agt plantegroei-eenhede word verskaf. Hierdie ekologiese eenhede behoort in ag geneem te word tydens die opstel van bestuursprogramme van natuurlike hulpbronne binne die studiegebied.

Keywords: Braun-Blanquet, classification, synecology, Grassland Biome, TWINSPAN.

Introduction

The Grassland Biome is one of the most important agricultural regions of southern Africa, both in terms of intensive crop production and extensive stock farming (Mentis & Huntley 1982; Scheepers 1986). Agricultural practices, urbanization, industrialization, coal mining and the encroachment of exotic plant species, have had a negative influence on the condition and stability of the ecosystems in the Grassland Biome (Mentis & Huntley 1982). Little of the natural vegetation is left and the remnants thereof are poorly conserved. The necessity to identify and describe the vegetation units within the Grassland Biome was stated by Mentis and Huntley (1982) and Scheepers (1986).

This study, with the study area situated in the Pretoria–Witbank–Heidelberg area, forms part of the Grassland Biome project (Scheepers 1986). The aim of this study is to establish a classification of the vegetation and associated ecological interpertation which should form the basis for managing natural resources and conservation of the biotic diversity (Mentis & Huntley 1982; Scheepers 1986). Apart from the Suikerbosrand Nature Reserve (Bredenkamp & Theron 1978, 1980), very little is known about the vegetation and associated environments of the Pretoria–Witbank–Heidelberg area.

Study area

The major portion of the study area lies within the Grassland Biome of South Africa and is situated between 28°00′ and 29°15′E longitude and 25°15′ and 26°30′S latitude (Figure 1), covering an area of approximately 11 250 km^2. Only a small portion of the northern part of the study area is situated in the Savanna Biome (Rutherford & Westfall 1986). The vegetation of the Ba and Ib land types within this area was surveyed previously (Land Type Survey Staff 1985, 1987). Acocks (1953, 1988) recognized five veld types in this region: Mixed Bushveld (veld type 18) in the extreme northern parts of the study area; Sourish Mixed Bushveld (veld type 19) bordering the Mixed Bushveld to the south; the Sour Bushveld (veld type 20) north-west of Pretoria; Bankenveld (veld type 61) in the central parts; and *Cymbopogon – Themeda* Veld (veld type 48) to the south-west. The vegetation within the study area shows similarities with the classification of Werger (1978), namely the Upland (Temperate) Sub-humid Mountain Bushveld, the Moist Cool Temperate Grassland, the Moist Cold Temperate Grassland and Azonal vegetation.

Climate

The annual average rainfall for the study area varies from 630 to 750 mm (Weather Bureau 1986). The rainfall is generally